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Title of invention

"Multifunction measuring instrument"
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MULTIFUNCTION MEASURING INSTRUMENT**OBJECT OF THE INVENTION**

The invention relates to a multifunction instrument for measuring biochemical and medical samples, which are preferably placed into the wells of the sample plates and measured by a detector.

PRIOR ART

The known measuring devices are usually intended for one measuring process, as for example radioactive labels, luminescence, several types of fluorescence or absorption. Also multifunction measuring instruments have been made, typically involving either non radioactive methods or radioactivity counting and luminescence. Instruments measuring both radioactive labels and fluorescence are not known to exist. The aim of the present invention is to solve the problems and provide a new multifunction instrument capable to measure all commonly used techniques

SUMMARY OF THE INVENTION

The present invention may be briefly described and summarised that the detector of the multifunction instrument is movable for using it at least with two different light paths.

PREFERRED EMBODIMENTS

According to a preferred embodiment of the invention the multifunction instrument is provided with a rotating device for rotating the detector in two different positions for two different light paths.

According to a second preferred embodiment of the invention in the first position the detector the first light path is provided for liquid scintillation counting and/or luminescence counting, and that the second light path is provided for fluorescence measuring.

According to a third preferred embodiment of the invention the multifunction instrument has a light source provided for excitation light with the second light path for fluorescence measuring.

According to a fourth preferred embodiment of the invention the multifunction instrument is provided with an absorbance detector to be used with the said light source.

According to a fifth preferred embodiment of the invention the detector is provided with slide and guide elements, the rotating device is provided to turn the detector into vertical position for liquid scintillation measuring and/or luminescence counting above the sample plate, and that the rotating device is provided to turn the detector into horizontal position for fluorescence measuring via the second light path.

The multifunction instrument according to the invention can measure radioactive labels by using liquid scintillation counting and/or luminescence counting process and also non-radioactive labels by using fluorescence process. For both of these measurements can be used the same rotating detector, a photo multiplier tube above the sample.

The second photo multiplier tube under the sample, primarily used in liquid scintillation counting for better efficiency, can also be used for absorbance measuring. However, the absorbance measurements can also be carried out with a separate absorbance detector, if there is no photo multiplier tube under the sample.

In that case the same light source can be used in the excitation of fluorescence measurement and in the absorbance measurement.

In liquid scintillation counting the radioactive labels such as tritium H^3 , radiocarbon C^{14} , phosphor P^{32} , iodine I^{125} and other beta emitting isotopes can be measured.

In fluorescence measurements the excitation light and the emission light have different wavelengths. The excitation light pulse of about $1\mu s$ is partly in UV area having wavelength of 240-500 nm. The light emitted from the sample label is visible light having wavelength of 400-650 nm. The prompt, time-resolved and polarization processes can be used.

For different type of sample plates in the measuring instrument there is a cover plate with different size apertures. For most common diameter of wells, 24 and 96 wells, to be measured there is an appropriate aperture in the cover plate.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention is described in the following by means of an example with reference to the appended drawings. However, the present invention should not be construed to be limited thereto. In the drawings

- Figure 1 shows a cross-sectional view of a multifunction instrument.
 Figure 2 corresponds to Fig. 1 and shows the multifunction instrument in a second measuring position.
 Figure 3 shows another cross-sectional view of a multifunction instrument.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT RELATIVE TO THE DRAWINGS

In Figure 1 there is a multifunction instrument 10, which has a transfer unit 11 for moving sample plates 12. The sample to be measured is placed into a well 13 of the sample plate 12. In the multifunction instrument 10 of Figure 1, which is an embodiment of the invention, there are two measuring detectors. The first measuring detector 20, which is a photo multiplier tube, is located above the sample well 13. It can be used e.g. as a liquid scintillation counter for measuring low energy radiation emitting samples and/or luminescence counting. For double detector measuring process in the multifunction instrument 10 there is optionally the second measuring detector 21, which is also a photo multiplier tube and locating under the sample well 13.

For measuring different kind of sample plates 12 there are cover plates 24 and 25 between the sample plate 12 and the detectors 20 and 21. The cover plates 24 and 25 are slides, which have measuring apertures of different size diameters. By moving the cover plates 24 and 25 in horizontal direction the measuring apertures for the detectors 20 and 21 can be changed. So e.g. the sample plates for 24 or 96 sample wells can be measured.

In the multifunction instrument 10 of Figure 1 the first photo multiplier tube 20 is presented in its first position for liquid scintillation counting and/or luminescence counting of the sample plate 12. For turning the photo multiplier tube 20 into the second position the tube 20 is provided with a slide pin 26 moving in a guide track 22. Then a rotating device 14 turns the detector anticlockwise the second measuring position described in Figure 2.

In Figure 2 the multifunction instrument 10 is presented in the second measuring position. In that position the first photo multiplier tube 20, locating above the sample well 13, has been rotated counterclockwise by a rotating device 14. In this position the same photo multiplier tube 20 can be used as a detector for fluorescence measuring. For this measurement the sample plate 12 and the sample well 13 to be measured has been moved to another location adjacent to the light path system 30. The excitation light is brought to the sample well 13 by the excitation light system 40, which is more detailed

described in Fig. 3. In the fluorescence measuring of Fig. 2 the emitted light from the sample well 13 of the sample plate 12 is directed through the lenses 31, 32 and filter 33 to the mirror 34, where the light is reflected to the detector photo multiplier tube 20.

- 5 Figure 3 shows the multifunction instrument 10 of Figure 2 seen from another side. The measuring process is the fluorescence measuring as described in Fig. 2. The excitation light is brought from the excitation light source 40 through a lens 42 and filters 43 and 44 via a mirror 41 to the sample well 13 of the sample plate 12. The emitted light from the sample well 13 is directed through the lenses 31, 32 and filter 33 to the mirror 34 and
10 reflected to the photo multiplier tube 20, as already described in Fig. 2. The excitation light mirror 41 is essentially smaller than the lens 31 in the emission light path. The ratio of the areas of the mirror 41 and lens 31 is about 1:40. In the excitation light path there is also a second mirror 45 for bringing light to a reference detector 46.
- 15 In the multifunction instrument 10 of Figure 3 there is also a cover plate 36 slide, which has apertures of different size diameters. By moving the cover plate 36 in horizontal direction an appropriate measuring aperture can be selected. So e.g. the sample plates for 96 sample wells or more can be measured.
- 20 The multifunction instrument 10 of Figure 3 is also provided with an absorbance detector 50 below the sample plate 12, which can be used with the said light source 40. Also on the opposite side of the excitation light source 40 there is space for some other optional measuring detector.
- 25 It is obvious to a person skilled in the art that the different embodiments of the invention may vary within the scope of the claims presented below.

REFERENCE NUMERALS

- 10 multifunction instrument
- 11 transfer unit
- 5 12 sample plate
- 13 well
- 14 rotating device
- 20 photo multiplier tube
- 21 photo multiplier tube
- 10 22 guide track
- 23 guide track
- 24 cover plate
- 25 cover plate
- 26 slide pin
- 15 27 slide pin
- 30 light path system
- 31 lens
- 32 lens
- 33 filter
- 20 34 mirror
- 35 aperture plate
- 36 cover plate
- 40 excitation light source
- 41 mirror
- 25 42 lens
- 43 filter
- 44 filter
- 45 mirror
- 46 reference detector
- 30 50 absorbance detector

CLAIMS

1. A multifunction instrument (10) for measuring biochemical and medical samples, which are preferably placed into the wells (13) of the sample plates (12) and measured by a
5 detector (20), characterized in that the detector (20) of the multifunction instrument (10) is movable for using it at least with two different light paths (24, 30).
2. A multifunction instrument (10) as claimed in claim 1, characterized in that the
10 multifunction instrument (10) is provided with a rotating device (14) for rotating the detector (20) in two different positions for two different light paths (24, 30).
3. A multifunction instrument (10) as claimed in claim 1 or 2, characterized in that
15 in the first position the detector (20) the first light path (24) is provided for liquid scintillation counting and/or luminescence counting, and that the second light path (30) is provided for fluorescence measuring.
4. A multifunction instrument (10) as claimed in claim 1, 2 or 3, characterized in
20 that the multifunction instrument (10) has a light source (40) provided for excitation light with the second light path (30) for fluorescence measuring.
5. A multifunction instrument (10) as claimed in any of claims 1-4, characterized in
that the multifunction instrument (10) is provided with an absorbance detector (50) to be
used with the said light source (40).
- 25 6. A multifunction instrument (10) as claimed in any of claims 1-5, characterized in
 - that the detector (20) is provided with slide (26, 27) and guide (22, 23) elements,
 - that the rotating device (14) is provided to turn the detector (20) into vertical position
for liquid scintillation measuring and/or luminescence counting above the sample plate
(12),
 - 30 - and that the rotating device (14) is provided to turn the detector (20) into horizontal
position for fluorescence measuring via the second light path.

(57) ABSTRACT

The object of the invention is a multifunction instrument (10) for measuring biochemical and medical samples, which are preferably placed into the wells (13) of the sample plates (12) and measured by a detector (20). The detector is movable with slide (26, 27) and guide (22, 23) elements so that a rotating device (14) can turn the detector into vertical position for liquid scintillation counting and/or luminescence counting. The second horizontal position and light path (30) is provided for fluorescence measuring with a light source (40) for excitation. Also an absorbance detector (50) is included.

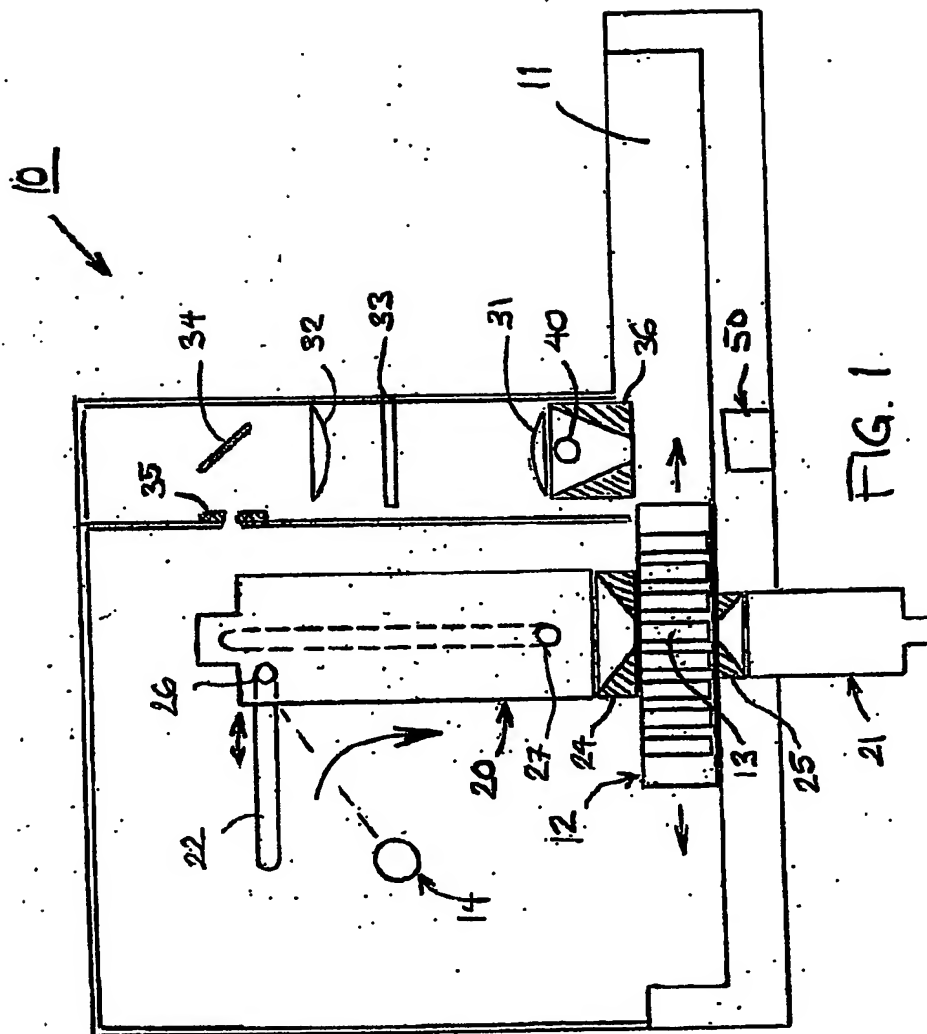
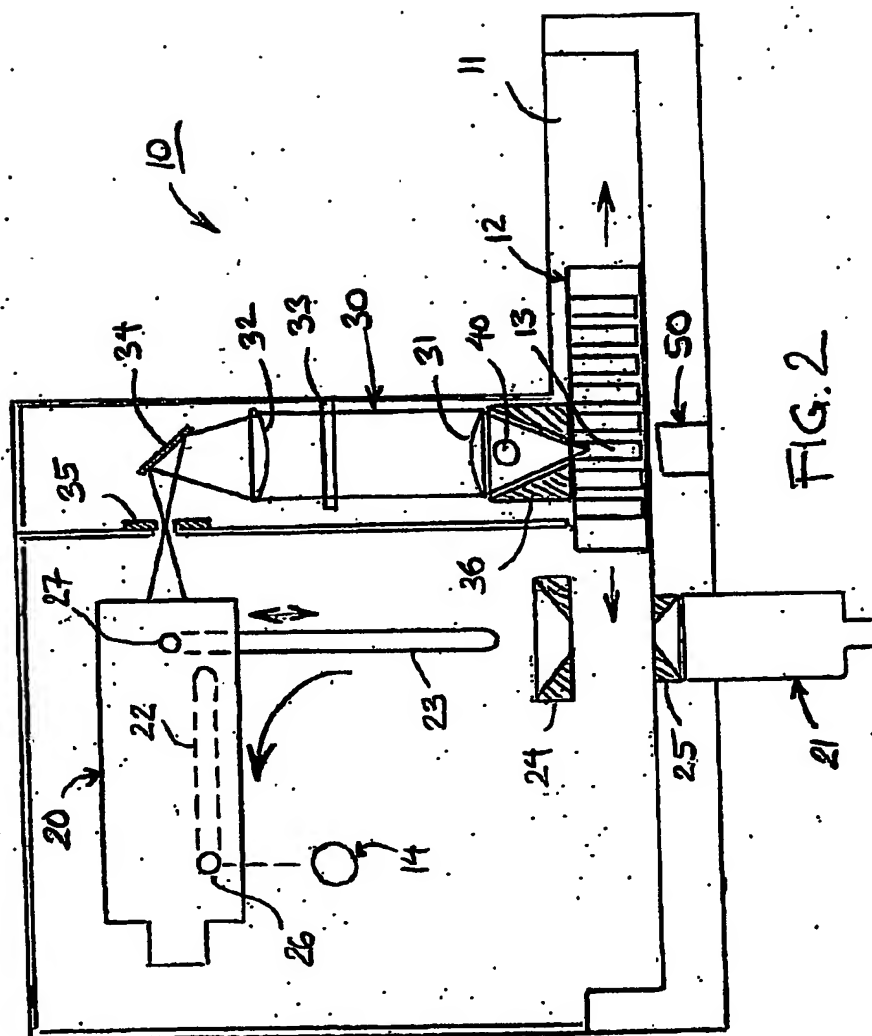


FIG. 1



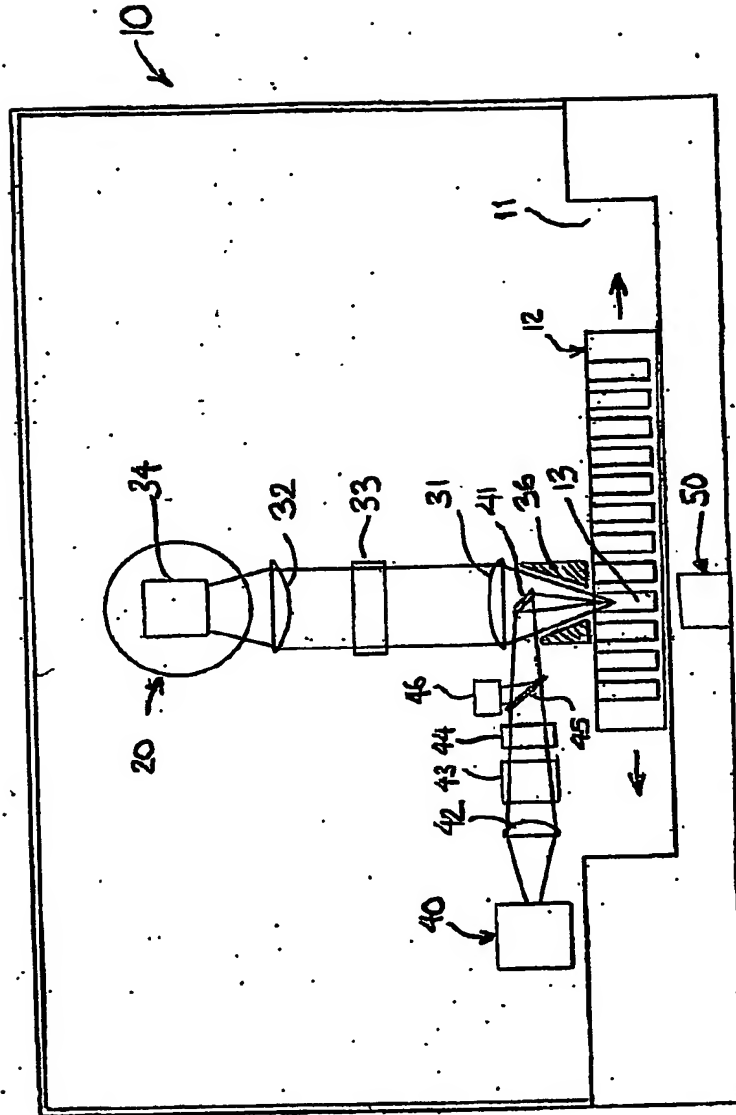


FIG. 3